CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9700 BIOLOGY

9700/21 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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Mark scheme abbreviations:

;	separates marking points
/	alternatives answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
ecf	error carried forward
I	ignore
mp	marking point (with relevant number)

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1 (a) *one mark for the stages of the cell cycle in the correct sequence*
one mark for correct matching of each stage with a cell

stage of mitosis	label from Fig. 1.1
prophase	**A** / **H** ;
metaphase	**G** ;
anaphase	**C** / **E** / **F** ;
telophase ;	**B** ;

[5]

(b) microtubules / spindle (fibres), attach to <u>centromere</u> / <u>kinetochore</u> (of chromosome during prophase) ; **I** metaphase
arranging / aligning / orienting / AW, chromosomes at the equator / metaphase plate ; **R** centre
fibres, shorten / contract / retract ; **A** microtubules disassemble / AW
move / pull, (sister) chromatids / (daughter) chromosomes, to opposite <u>poles</u> / <u>centrioles</u> ;
idea that equal number of chromosomes in each daughter, nucleus / cell ; [max 2]

(c) maintaining number of chromosomes ;
ensuring genetic stability / maintaining genetically identical cells / AW ;
asexual reproduction ; **A** vegetative reproduction / cloning
cloning / clonal expansion, of (named) lymphocytes ; **A** B / T cells
replacement of (worn out / dead / damaged) cells ;
regeneration, of (named) tissues / organs ;
(wound) repair (of tissues) ; **R** repair of cells
ref. to production of gametes ;
e.g. mitosis in gametogenesis / gamete production in plants
R 'copying of cells' [max 2]

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(d) (i) *accept biological N fixation or Haber-Bosch process for mp1*

1 *either*
converts, (inorganic) nitrogen / dinitrogen / N_2, into organic nitrogen / ammonia / NH_3 / ammonium / NH_4^+ **;** **R** if nitrate given
or
lightning converts, nitrogen / ammonia / NH_3 / ammonium / NH_4^+, into, nitrite / nitrate (ions) **;**

2 reduces nitrogen / breaks triple bond **;**

3 makes (fixed) nitrogen available to, legumes / other organisms / community / AW **;** **A** ref. to amino acids / proteins
not to be awarded if it follows nitrification

4 increase soil fertility **;**

5 balances the loss of fixed nitrogen in, denitrification / ocean deposits **;** [max 2]

(ii) 1 *idea of* decay / decomposition **;**
e.g. breakdown by, (saprophytic) bacteria / fungi

2 legumes eaten by, detritivores **;** **A** named detritivores

3 decomposers produce proteases **;**

4 to, hydrolyse / convert / change / AW, protein to amino acids **;**

5 amino acids are deaminated **;**

6 (amino acids) to, ammonia / NH_3 / ammonium (ions) / NH_4^+ **;**

7 nitrifying bacteria / *Nitrosomonas*, convert ammonia to nitrite (ions)**;**

8 nitrifying bacteria / *Nitrobacter*, convert nitrite to nitrate (ions) **;**

if mp7 or mp8 not awarded allow one mark for the following as mp9
9 (named) nitrifying bacteria convert, ammonia / ammonium, to nitrate (ions) **;**

mp10 only to be awarded following nitrification
10 nitrate (ions) used for making, amino acids / proteins (hence increase in growth of cereals) **;**

[max 2]

[Total: 14]

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2 (a) (i) **X** – (ciliated) epithelium **;**
Y – red blood cell / erythrocyte **;** [2]

(ii) cilia beat to move mucus (up the bronchiole / towards the mouth / away from the lungs / AW) **;**
mucus as a barrier to entry into (epithelial) cells **;**
mucus traps, pathogens / bacteria / microbes **;** *accept in context of goblet cells*
capillary / blood vessel, brings, phagocytes / macrophages (to engulf bacteria) **;** [max 3]

(b) (i) **J** – phagocytosis / endocytosis / described in terms of engulfing *or* forming phagosome **;** [1]

(ii) digestion of bacteria / described **;**
to destroy bacteria / pathogen **; A** to prevent spread through the body
antigen, presentation / display on cell surface **;**
idea of selection of specific, B cells / T cells **;**
A recognition / binding of / activation of, appropriate B / T cells [max 2]

(c) 1 faster **;**
in context of whole secondary response

2 memory cells**;**
in context of production during the first response

3 *idea that* there are many more cells specific for this pathogen **;**

4 (so) increases chances of encountering pathogens more quickly / AW **;**
5 fast(er) production of, B lymphocytes / plasma cells / antibodies / helper (T) cells / cytotoxic T cells / cytokines **;**
6 greater concentration of antibodies (in, blood / lymph) *or* greater numbers of, B / plasma, cells **;**
A more, antibodies / plasma cells / B cells

7 pathogen, removed / killed, faster **;**
8 person does not become ill / no symptoms **;**
A pathogen does not, spread through the body / infect cells / AW [max 3]

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(d) (i) little / no / slower / weak, immune response ;
stated function of T-lymphocytes, does not occur / occurs slowly ;
e.g. release of cytokines / stimulating macrophages / stimulating B cells / killing infected cells
high susceptibility to infectious diseases ;
R 'fighting disease' [max 1]

(ii) pathogen **not** recognised, as non-self / foreign ;
pathogen is recognised as self ; **A** non-foreign
ignore antigen concealment [max 1]

(iii) no, antibodies / plasma cells / memory (B) cells, produced ;
no humoral response ;
no antigen presentation by B cells ; [max 1]

[Total: 14]

3 (a) increased / faster, movement / diffusion, of, assimilates / amino acids / sucrose / water / solutes / ions / molecules ;
I substances / particles / carbohydrates
I freely / easily / efficiently
I osmosis

(because) more, (symplast) pathways / passages / AW ;
accept in context of blockage of some plasmodesmata

correct ref. to symplast pathway in context of an advantage ;

e.g. of complex plasmodesmata ;
from companion cell into sieve tube (elements) / when loading sucrose into phloem

AVP ; e.g. selectivity / control / regulation, of movement [max 2]

(b) 1 mass flow ; **A** pressure flow

2 sucrose / solutes / assimilates / sugars, decreases, water potential / solute potential ; **A** symbol(s) Ψ

3 water enters (sieve tubes), down water potential gradient / by osmosis ;

4 increase in / high(er), <u>hydrostatic</u> <u>pressure</u> ;

5 unloading / removal, of sucrose at the sink lowers the (hydrostatic) pressure ;

6 movement (from source to sink) is by gradient in (hydrostatic) pressure ; [max 4]

[Total: 6]

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4 (a) enzyme **A** uses 'lock and key' **and** enzyme **B** uses induced fit **;**
A enzymes work by 'lock and key' and induced fit
enzyme **A** / lock and key, (shape of) active site is complementary / AW, to (shape of) substrate (molecule) **;**
enzyme **B** / induced fit, has an active site that, moulds around / AW, the substrate **;** [3]

(b) (i) 1 **P** is β-pleated sheet, **Q** is α-helix **;**
accept if P and Q are identified by a description

2 determined by, coiling / folding / sequence, of amino acids / polypeptide **;**
A primary structure for sequence of amino acids

3 stabilised / held / AW, by hydrogen bonds **;**

4 between C = O and H–N (of peptide bonds) **;**
A carbonyl / carboxyl group, and, amine / amino group

5 ref to, parallel / anti-parallel, nature of β-pleated sheet **;** [max 3]

(ii) 1 catalyses reaction between carbon dioxide and water to form carbonic acid **;**
A correct, formulae / equation

2 very fast reaction **;**

3 in (cytoplasm of) red blood cell / erythrocyte **;**

4 (so there are) hydrogen ions / protons, and hydrogencarbonate ions **;**

5 hydrogen ions promotes oxyhaemoglobin dissociation / AW **;**
e.g. reduces affinity of haemoglobin for oxygen / (oxy)haemoglobin gives up oxygen more readily

6 increases supply of oxygen to (respiring) tissues **;**

7 carbon dioxide is transported as hydrogencarbonate ions **;**

8 in the plasma **; A** carbon dioxide diffuses from red blood cell to plasma

9 AVP **;** e.g.
carbonic anhydrase catalyses reverse reaction in the lungs
ref to hydrogencarbonate ions as buffer in plasma (as a consequence of reaction)
R buffering action of haemoglobin in red blood cells [max 4]

[Total: 10]

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5 (a)

structural feature	triglyceride	phospholipid
phosphate (group) / contains phosphorus	×	✓
nitrogen	×	✓
charged / polar	×	✓
(number of) fatty acids	3	2
number of ester bonds	3	2
number of phosphate ester bonds	0	1
award one mark for any of the following comparisons		
number of double bonds (in hydrocarbon chain)	0	1
number of saturated fatty acids / ORA	3	1
presence of double bonds	×	✓
presence of unsaturated fatty acids	×	✓

These are alternatives – award one mark only

[max 2]

(b) *answer may be phrased in the context of amylase / trypsin*
ignore anything before Golgi, e.g. shuttle vesicles from RER

1 vesicles, form from / 'pinch off', Golgi (apparatus / body / complex) ;

2 vesicles moves, through cytoplasm / to cell (surface) *or* plasma membrane ;

3 role of cytoskeleton / microtubules in movement of vesicles ;

4 energy / ATP, is required (movement of vesicles / fusion with membrane) ;

5 vesicle fuses with / AW, cell (surface) / plasma, membrane ;
I bind / attach **A** join / merge / becomes part of

6 exocytosis / vesicle 'opens up' so that enzyme molecules are released ;

7 ref to fluid nature of, membranes / phospholipid bilayer, that makes this possible ; [max 4]

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(c)

role of water	property of water
solvent for glucose and ions	dipolar / polar ; **A** description of polarity of water
transport in the xylem	hydrogen bonding ; **I** cohesion / adhesion
helps to decrease body temperature in humans	high latent heat of vapourisation / high specific heat (capacity) / high enthalpy heat of vapourisation / lots of energy required for evaporation ;

[3]

[Total: 9]

6 **(a)** **P** – thymine ; **R** thiamine / thiamin / thyamine
Q – cytosine ;
R – guanine ;
S – uracil ; [4]

(b) **1** copy of the, DNA / gene, (coding) for a, polypeptide / globin ; **A** protein

2 travels from, DNA / nucleus / chromosome, to ribosome ;
A mRNA made in nucleus, attached to ribosome *so movement is implied*

3 for translation / for (haemo)globin production ;

4 mRNA codes for, sequence / order, of amino acids ; **A** for primary structure

5 *idea that* (nucleotide / base) sequence is a series of codons ;

6 base pairing / AW, between codon on mRNA and anticodon on tRNA ;
e.g. of AW
hydrogen bonds between bases
examples of base pairing: A–U / C–G
R binding between bases [max 3]

[Total: 7]

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AVP	alternative valid point

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1 (a) A right ventricle **;** **A** r. ventricle **R** RV

B vena cava **;** **A** vena cavae
I superior / upper / inferior / lower / posterior
R if other terms used

C atrioventricular node **;** **A** AVN

D coronary arteries **;** **A** coronary artery **A** coronary capillaries
I coronary vessels

E bicuspid / left atrioventricular / mitral (valve) **;** **[5]**

[Total: 5]

2 (a) 1 cilia, qualified **;** e.g. absent / short / destroyed / smaller / damaged / AW
R cilia killed **R** hairs for cilia **R** mucus damages cilia
A ciliated (epithelial) cells, absent / destroyed / damaged

2 ref. to presence of, scar tissue / scarring **; BOD** scar
R cilia are scarred (idea is, scar tissue formation / more connective than usual)
note idea of scar tissue in place of, cilia / ciliated epithelium = 2 marks

3 idea of affecting, coordinated movement / synchronous rhythm, (of cilia) **;**
A cilia paralysed
A if stated that excess mucus inhibits movement
A ecf if 'hairs' instead of cilia for mp 1

4 mucus, not moved (effectively) **/** accumulates **;**

5 idea that, bacteria / *B. pertussis* / *Bordetella* / pathogens, accumulate (in airways) / are trapped in mucus
A mucus, good growth medium for pathogens / AW **[max 3]**

(b) mucous gland **;** **A** mucous glands **[1]**

(c) if another mode of transmission given (e.g. faecal-oral / contact / sexual transmission) = 0 marks for this part-question **I** in unpasteurised milk

1 aerosol / droplet, infection **;**

only need to have one of 'infected' / 'uninfected' to gain mps 2 and 3

2 infected / AW, person, coughs / breathes / spits / talks / sneezes **;**

3 uninfected / AW, person, inhales / inspires / breathes in, droplets **;**

2 / 3 *allow one mark if mps 2 and 3 given with no reference to, infected / uninfected*

4 organism / pathogen / bacteria / *B. pertussis*, in, airborne droplets / droplets in air **;**
A without 'airborne' or 'in air' *if mp 2 gained* **[max 2]**

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(d) (i) **1** DNA / gene / *MUC5AC*, unwinds / AW **;** **I** unzips
2 H-bonds break between, (complementary) bases / base pairs / strands **;**
I unzips
3 one / a, strand, acts as template / (complementary) copied **;**
I ref. to**,** sense / coding and antisense / non coding
4 ref. to (involvement of) RNA polymerase **;**
I ref. to direction of, movement / strand formation
5 (free) complementary RNA nucleotides added **;**
A described in terms of correct base-pairs (C with G and A with U minimum)
6 step-by-step / sequentially **/** AW **;**
7 sugar phosphate backbone sealed **/** phosphodiester bonds formed **;**
A sugar phosphate backbone formed
8 (product is) messenger RNA / mRNA **; A** primary transcript
9 AVP **;** e.g. transcription factors required to initiate transcription
RNA polymerase binds to promoter (sequence)
helicase unwinds
ref. to activated (RNA) nucleotides
ref. to proof reading
(transcription ends at) transcription terminator **[max 4]**

(ii) Golgi (body / complex / apparatus) **;**
A RER / rough ER / rough endoplasmic reticulum
one of
2 transport / movement, to cell (surface) membrane (from Golgi) **;**
A through cytoplasm (for Golgi or RER)
A transport to Golgi *if RER given in mp1*
3 ref. to bulk transport, across cytoplasm / to cell surface membrane **;**
4 ref. large size and difficulty of movement across, cell / cell surface membrane **;**
5 it, functions extracellularly / is released to the outside of the cell / is secreted **;**
I ref. to exocytosis *as it is in the question* **[max 2]**

(e) **1** shortness of breath / dyspnea / difficulty breathing / restriction of airflow **;**
A rapid breathing **R** heavy breathing
2 chronic / persistent / AW, cough / coughing **; I** cough, blood **/** mucus
A constant coughing **A** smoker's cough
3 chest tightness **;** **A** chest pain **R** heart pain
4 wheezing **;**
5 fatigue / weakness **;**
6 difficulty, when exercising / with physical activity / with mobility **;**
7 more prone to / frequent, chest / respiratory / named, infections **;**
8 barrel (shaped) chest **;**
9 cyanosis (blue, face / fingers)
10 AVP **;** e.g. weight loss **/** anorexia
swollen, ankles / feet
not excess mucus as this is in the question **[max 4]**

[Total: 16]

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3 **(a)** same, water potential / Ψ(inside + outside) / no water potential gradient **;**
A same solute potential **I** osmotic potential
(so) no, net / overall, movement of water (molecules) **;**
A osmosis does not occur **[2]**

(b) *for two marks match correct plasma component and, mechanism / membrane component if no mechanism given*

plasma component ;	**mechanism ;**	**membrane component ;**
oxygen carbon dioxide steroids / steroid hormones	(passive) diffusion **A** movement from high to low concentration	(phospho)lipid bilayer / hydrophobic core (of membrane)
glucose amino acid(s) named amino acid mineral / inorganic, ions named ion e.g. sodium ions / Na^+, magnesium ions / Mg^{2+} chloride ions / Cl^-, hydrogen ions hydrogen carbonate ions / HCO_3^- phosphate ions / HPO_4^{2-} potassium ions (K^+)	facilitated diffusion **;** **A** active transport **A** cotransport	transport(er) / carrier / integral / intrinsic / transmembrane, protein **;** **A** channel protein for facilitated diffusion **A** pump protein for active transport

A urea, with any of the three mechanisms and relevant membrane component to match the mechanism stated **[3]**

(c) (x) 1000 **;; A** (x) 947 / 947.4 or 1053 / 1052.6
if units given = one mark only

if incorrect allow one mark for correct length measured 9 / 9.5 / 10 mm and knowledge of formula is correct (magnification = image length / actual length – this can also be seen by workings e.g. 9.5 mm ÷ 9.5 μm) but incorrect conversion factor used for final calculation **[2]**

(d) *feature = one mark, with appropriate explanation = one mark*

F red blood cells / haemoglobin, close to body cells **;**
F (capillary) endothelium / capillary wall, one cell thick / thin **; A** epithelium
E short distance / AW (for oxygen to move to cells) **;**

F ref. to, diameter / size, red blood cell and capillary (lumen) similar **;**
E slows down flow (to allow sufficient oxygen to move out) / short distance (for oxygen to move to cells) **;** **[max 2]**

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(e) no / fewer, gaps / fenestrations / pores, in endothelium / capillary wall **;**
A spaces
ref. tight junctions between (endothelial) cells **; A** epithelial cells
idea that cells wrap round / fewer cells make up capillary wall, so reduces (endothelial) cell-cell contact **;**
idea of layer around capillary / basement membrane, impermeable **;** **[max 1]**

[Total: 10]

4 **(a)** either diagram A or B below (or more detailed – e.g. all carbons and all bonds shown in diagram A) **;;**
A CH_30 for CH_2OH
I incorrectly numbered carbons

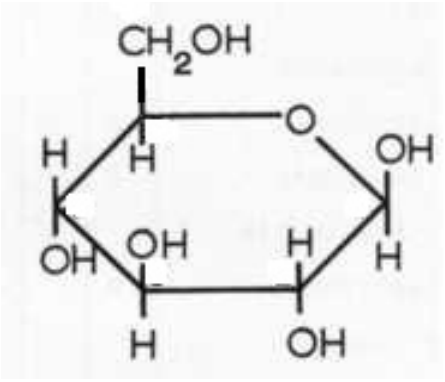


diagram A

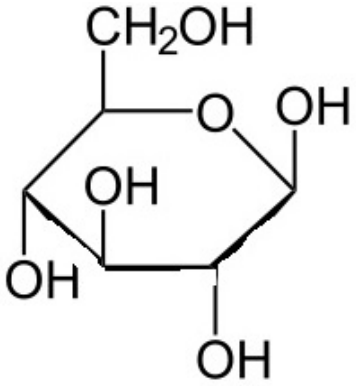


diagram B

if incorrect (e.g. If one or more H missing from the ring in diagram A ***or*** *if an H added to diagram B ring) allow one mark if*:

- hexose ring with oxygen shown in correct position and
- CH_2OH group in correct position and

OH groups of ring in correct position. **[2]**

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(b) (i) accept *T. maritima* or **T** and *A.tumefaciens* or **A** throughout for the β-glucosidases
*accept **T** if stated as **B** (as long as **A** is clearly mentioned)*
*if only **A** or **T** stated, look for comparative phrase*
compare optimum temperatures

1 optimum temperature, **A** lower (than **T**) / **T** higher (than **A**) **;**
A maximum activity **A** is at a lower temperature

2 40 °C(**A**) v 85° C(**T**) / **A** lower by 45 °C **;**

3 one difference in shape of curve before or after optimum **;**
e.g. after optimum, **T** does not have the less steep decrease after the initial steep decrease (unlike **A**)
before optimum, steepest increase for **A** is at the lower temperatures, (unlike **T**)

compare activity below and above 55 °C

4 below 55 °C, **A** has a higher activity **/** above 55 °C **A** has a lower activity, (than **T**) **;**
ora
A has a higher activity at low(er) temperatures and a lower activity at high(er) temperatures ora

5 comparative data to support mp 4 **;**

compare temperature ranges of activity

6 temperature range for activity is greater for **A ;** ora

7 (**A**) spans 80 °C v (**T**) spans 65 °C **; A** (**A**) 10–90 °C v (**T**) 30–95 °C

*compare **L** for both*

8 **A** has a lower, **L** / lowest temperature for (detectable) activity **or** ora
L is 20 °C lower for **A ; A** 10 °C (**A**) v 30 °C (**T**) **;**

9 (at **L**), A (relative) activity = 35%, **T** = 10% **;**

*compare **H** for both*

10 **T** has a higher, **H** / highest temperature for detectable activity **or** ora
H is 5 °C higher for **T ; A** 95° (**T**) v 90 °C (**A**) **;**

11 (at **H**) (relative) activity = 4%, **T** = 60% **;**

if mp 10 data given to support mp 1, then CON = no marks for mp 1 or 10 **[max 4]**

(ii) **1** primary structure, dictates, folding of the polypeptide chain / tertiary structure **;**
A idea that differences in primary structure leads to differences in, secondary / tertiary, structure
A in terms of folding to give the active site

similarity

2 same / (very) similar, (shape of) active site **;**

3 active site (shape) is complementary to / AW, substrate / cellobiose **; R** matches
A ES complex forms

differences

4 differences in, side-chain / R-group, interactions / AW **;**

5 qualified **;** e.g. differences in, numbers / types, of bonds
differences in bonding to give different stabilities
R different bonds without further qualification
R peptide bond

6 suggestion for thermal stability of **T ;** e.g. more bonds / more of a named bond type

7 suggestion of how active site may work in different ways **;**
e.g. at lower temperatures, **T** induced fit mechanism may mean active site does not mould fully round substrate **[max 4]**

[Total: 10]

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5 (a)

A *reverse wording for both*
mark vertically / one mark each correct column

description of event	outcome for the individual	production of memory cells / yes or no	precise type of immunity acquired by individual
individual **P** is injected with a live, weakened disease-causing organism	individual **P** does not become ill from the disease and has long-lasting protection from the disease	yes	artificial active
individual **Q** is exposed to a disease-causing organism and is immediately injected with a specific antibody	individual **Q** does not become ill from the disease but suffers from the disease a year later	no	artificial passive

[2]

(b) bone marrow **;** **A** stem cells / myelocytes **I** white blood cell **[1]**

(c) (i) **1** healthy body cells, (recognised as) self / have self-antigens **;** **A** non-foreign
2 cancer(ous) / tumour, cells, (recognised as) non-self / have non-self antigens **;** **A** foreign
3 idea that changes occur to structure of cell surface membrane of, cancer(ous) / tumour, cells **;**
4 phagocytes have receptors for, non-self / foreign, antigens **or** phagocytes have receptors for antibody complexed to non-self / foreign antigens **;**
[max 2]

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(ii) **1** uncontrolled / AW, mitosis / (mitotic) cell division / cell replication / cell cycle **;**
either
2 one example of a change occurring in a healthy cell
e.g. proto-oncogene to oncogene
mutation of / switching of, tumour suppressor gene
uncontrolled growth
increase in growth proteins
shorter interphase (of cell cycle)
(rapid) DNA replication
cells do not respond to signals (from other cells)
or
further detail of tumour formation **;**
e.g. cells immortal / no apoptosis / no programmed cell death
no contact inhibition / cells continue to grow when they contact other cells
cell cycle checkpoints not controlled
abnormal / AW, mass of cells formed
undifferentiated / unspecialised, cells / tissue / mass
cells do not function (as tissue of origin) **[2]**

[Total: 7]

6 **(a)** **(i)** (a) habitat **;**
(a) population **;**
producers / organisms **;** **[3]**

(ii) (a) niche **;**
(an) ecosystem **;** **[2]**

(b) **(i)** *energy losses from*

1 reflection (from leaf surface) **;**
2 idea that some light, passes through (leaf) / misses chloroplasts / strikes non-photosynthetic tissue **;**
A suggestion that cell walls may not allow all of light through
3 heating plant **; I** lost as heat to surroundings **A** converted to heat
4 evaporation **; A** transpiration
5 not all light (reaching chlorophyll) is, the right wavelength (for photosynthesis) / AW / absorbed by chlorophyll **;**
A idea that only a proportion of light energy is useable
A absorbed and, lost as phosphorescence / lost as luminescence / re-emitted
6 ref. to photosynthetic process inefficient **; A** loss of heat energy <u>during photosynthesis</u>
7,8 AVP **;;** e.g. ref. to photorespiration
ref. to factors that limit photosynthesis **[max 3]**

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(ii) **1** increased production of / more, biomass / plant matter / named (e.g. carbohydrate / cellulose / starch / oils) **;** **R** more plants **I** more crop **I** food
2 (so) more energy / more energy stores **;**
A more chemical energy produced
A higher energy
A suggestion that high PE crop may be more energy dense
3 more crop / greater yield, per unit, area / volume / time **;** **A** each year
4 idea of (comparatively) less space required (for growing) **;**
5 ref. to supplying increasing demand for, food / fuel **;**
6 more, profit (for farmers) / economic / AW **;** **I** cheaper
7 AVP **;** e.g. efficient use of carbon dioxide **[max 2]**

(iii) *credit all valid answers – this list is not exhaustive*

e.g. compound	**e.g. function of compound**
amino acids	production of proteins (for cell growth)**;** **A** provide energy / for respiration
proteins	cell division / mitosis / increase in cell number / increase in, biomass or yield / (cell) membranes **;** **A** reproduction **A** cell cycle **A** (tissue) repair **A** provide energy / for respiration
enzymes	synthesis of, macromolecules or organic molecules / anabolic reactions / for photosynthesis / for respiration **;** **[max 2]** **A** named molecules e.g. carbohydrates / amino acids / proteins / lipids / nucleic acids
(organic / nitrogenous) bases	component / synthesis of, nucleotides component of, DNA / RNA / nucleic acids **;**
nucleotides	component / synthesis of, DNA / RNA **;**
DNA	ref. genes / genetic material / coded information / genetic information, (for protein synthesis) **;**
RNA	ref. transcription / translation / protein synthesis **;**
(some) phospholipids	(for cell) membranes **;** **R** lipids
ATP	synthesis / anabolic reactions / active transport / translocation / described **;** **A** provide energy for reactions
chlorophyll	photosynthesis / light (dependent) stage **;**
NADP	(in) photosynthesis / light (dependent) stage **;**
NAD	(involved in) respiration **;**
FAD	(involved in) respiration **;**
auxin	growth hormone / cell elongation / cell division **;**
cytokinin	growth hormone / root growth **;**

[Total: 12]

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MARK SCHEME for the May/June 2015 series

9700 BIOLOGY

9700/23 Paper 2 (AS Structured Questions), maximum raw mark 60

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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

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1 **(a)** phospholipid (and protein) molecules, move about / diffuse / AW **;**
protein (molecules), scattered / AW **;** **A** different proteins present [2]

(b) *similarity to max 1*
(contains) phospholipid (bilayer)**;** **A** detail of orientation of phospholipid
A lipid bilayer
(contains) protein **;**

difference (look for ora)
(Davson Danielli) layer(s) of protein / protein only on outside **;**
(fluid mosaic) ref. to proteins, in different locations discrete / different types / named or described **;**
(fluid mosaic) presence of cholesterol (molecules) **;** [max 2]

(c) **1** requirement for, energy / ATP **; R** ATP energy
2 uses, carrier / transport, protein **; A** pump
3 conformational change (of carrier protein) **;** AW
4 moving against a concentration gradient **; A** low to high concentration
5 specific, binding site **; A** ref. to specificity to substance moved across [max 3]

to max 2
(d) **1** loss of, tertiary structure / quaternary structure / secondary structure **;**
A loss of shape of active site *in correct context*
2 loss of globular, shape / structure / form **;**
3 breakage of, ionic / hydrogen / hydrophobic, bonds / interactions **;**

to max 2
4 loss of function of (membrane) proteins **;**
5/6 detail **; ;**
e.g. transport of, polar molecules / ions, impaired AW
loss of cell to cell adhesion
unable to receive cell signals
loss of enzyme function
7 ref. to membranes, become leaky / lose partially permeable nature **;**
A cannot regulate, entry / exit, substances
8 disrupt interaction between protein and phospholipid bilayer / described **;** [max 3]

[Total: 10]

2 **(a)** (late) interphase **/** phase / after G1 phase / before G2 phase **;**
A after first growth phas**e /** before prophase / before mitosis / after cytokinesis [max 1]

(b) **(i)** hydrogen / H, (bonds) **;** [1]

(ii) Y, single ring structure **; A** smaller molecule compared to **X** [1]

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(c) (i) change in, nucleotide / base, sequence of DNA ;
any one from
new allele fomed ;
deletion / substitution / addition / frame shift , (mutation) ;
change to / altered, mRNA ; **A** altered codon(s)
(causing) change in, primary structure / amino acid sequence, of, polypeptide / protein ;
A different protein / altered function of protein / non-functional protein [max 2]

(ii) cell cycle shorter / interphase shorter / division more frequent ;
(cell cycle) checkpoints not controlled ;
uncontrolled (growth / division) / AW ;
AVP ; e.g. no differentiation (into epithelial cell)
A no cell death / apoptosis [max 2]

[Total: 7]

3 (a) (endoplasmic reticulum / RER) has ribosomes ;
(ribosomes / RER) site of protein synthesis ;
antibodies are proteins ;
RER for, modification / transport / transport vesicle formation ; [max 2]

(b) 3000 ;; **A** 2933 / 3067 *if units given allow one mark only*
if incorrect allow one mark for correct length measured 44 / 45 / 46 mm and knowledge of formula is correct (magnification = image length / actual length – this can also be seen by workings e.g. 45 mm / 15 μm) but incorrect conversion factor used for final calculation [2]

(c) Variola (virus) ; [1]

(d) memory cells produced (along with plasma cells) ;
to max 2
idea of greater number of (specific immune system) cells ;
(memory cells are) long(er) lived / remain in circulation ;
memory T and B cells ;
ref. to / detail of, faster secondary response (to give immunity) ; [max 3]

(e) *two relevant e.g.*
1 vaccine, thermostable / freeze-dried ; **A** *idea of* longer shelf-life / no wastage
2 virus did not mutate ; **A** pathogen / strain
3 same vaccine could be used everywhere ;
4 cheap to produce (in large quantities) ;
5 ease of production ;
6 used a live virus / vaccine gave a strong immune response ;
7 no need for boosters ;
8 ease of administration ; e.g. ref. to enthusiastic volunteers
needles could be, sterilised / re-used
9 high percentage cover / AW ;
10 ref. to ring vaccination / described ;
11 global effort / AW ; [2]

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(f) artificial active / active artificial **;** [1]

[Total: 11]

4 (a) (i) ***A*** *bp for blood pressure throughout*

1 bp decreases with distance (from, heart / LV) **;**
A named vessels to indicate distance

2 difference between minimum and maximum bp decreases (with distance) **;**

3 maximum and minimum bp are the same, at the capilaries / after arterioles **;**

4 (BP) reaches zero kPa, at large veins / vena cava(e) **;** **A** after small veins
A no blood pressure

5 steepest decrease in bp between aterioles and capillaries **;**

6 correct data quotes **;**
e.g. mp 1 from 16 kPa to 0 kPa for maximum bp
mp 1 from 10.6–10.8 kPa to 0 kPa for minimum bp
mp 2 11.6 / 11.8 kPa, in aorta / nearest to left ventricle and 0 kPa at capillaries
mp 3 (same bp of) 5 kPa [max 3]

(ii) (presence of) valves **;** **R** bicuspid / tricuspid, valves
to stop backflow / allows one-way flow / flow only towards heart **;** [max 2]

(b) hydrolysis **;** **A** breaking bond using water
(of / breaking of) peptide bond **;**
between Phe and His / Phe-His bond **;**
removal of, two amino acids / His and Leu / dipeptide **;** [max 3]

(c) 1 (ACE) inhibitor / drug, has similar shape as, substrate / polypeptide **;**

2 complementary (shape) to active site (shape) **;**

3 binds to / fits into / enters, active site (of ACE enzyme) **;**
A forms enzyme-substrate complex

4 substrate cannot, enter / bind **;**
A competes with substrate for active site
A no / few / prevents formation of, ES complexes

5 reduces rate of, reaction / formation of angiotensin / product formation **;** [max 3]

[Total: 11]

5 (a) (light microscope) observe living cells / cells would be killed (with EM) **;**
vacuum used in electron microscope **;**
(light microscope) can have water on slide (to allow cells to move) **;** ora
AVP **;** e.g. more readily available for use
organisms move in response to light [max 2]

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(b) (i) (part of / used in synthesis, of) chlorophyll (molecule) **;**
R gives chlorophyll green colour

in translation / joining of large and small subunits (of ribosomes) **;**

enzyme, cofactor / activator / described **;** *idea of role in enzyme catalysis*
A correctly named enzymes e.g. DNA polymerase

AVP **;** e.g. stabilizing, cell wall / proteins / nucleic acids / membranes
important in energy transfers / ATP synthesis
DNA, synthesis / replication
ref. to role in, light absorption / capture (for photosynthesis) [max 1]

(ii) *any two from*
1 good solvent / polar (for substances needed by the organism) **;** AW
2 transparent / allows light through, (for photosynthesis) **;**
3 liquid over wide range of temperatures **;**
4 high specific heat capacity **; A** description
5 high latent heat of vaporisation **;**
6 ref. to density **;** e.g. ice / solid, less dense than, water / liquid
circulation bringing nutrients to surface
7 ref. to low viscosity for locomotion **;** [max 2]

(c) *assume multicellular organisms unless stated, then accept ora*
1 small, surface area to volume ratio / SA:V **;**
A as organisms increase in size, SA:V decreases
2 ref. to (larger size means) long distances (to reach, cells / tissues) **;**
3 diffusion, too slow / insufficient / unable to satisfy needs **;**
4 transport system decreases time to supply cells **;**
5 require, bulk / mass, flow **;**
6 ref. to transport system means efficient supply (to cells) of nutrients / named / assimilates / water **; A** brings supplies close to cells (for transfer) [max 4]

(d) 1 mass flow **; A** pressure flow
2 sucrose / solutes / assimilates / sugars, decreases, water potential / Ψ**;**
A more negative / lowers, water potential
A for water potential **A** solute potential
3 water enters (sieve tubes) by osmosis **;**
4 (water enters) down water potential gradient **;**
5 (increased volume) increase in / high(er), hydrostatic pressure **;**
ref. to hydrostatic required once only in mp 5 or mp 7or mp 8
6 unloading / removal, of sucrose / AW, at the sink / named sink **;**
7 lowers hydrostatic pressure / low pressure at sink **;**
8 movement is, down pressure gradient / from high to low (hydrostatic) pressure **;** [max 5]

[Total: 14]

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6 (a) (i) nitrification **;** [1]

(ii) by bacteria **;**
denitrification / reduction**;**
ref. anaerobic conditions **;** **A** ref. to waterlogging [max 2]

(b) (i) *idea of* (unit made up of) biotic and abiotic, components **;** AW
further detail **;** interacting / functioning together **;**
A *idea of* self-sustaining unit [2]

(ii) carries out photosynthesis / converts light (energy) to chemical energy **;**
A (photo)autotrophic
synthesises (complex) organic compounds from inorganic, compounds**;**
(occupies) lowest / first trophic level **;** **A** acts as a producer [max 1]

(iii) place where an organism lives **;** **A** population / species / community [1]

[Total: 7]

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